APPENDIX E

FY 2001 Federal Laboratory Consortium Awards to the Department of Defense

Appendix E: FY 2001 Federal Laboratory Consortium (FLC) Awards

2001 FLC Representative of the Year: Kristen Schario

As FLC Representative of the Year, Ms. Schario has provided excellent leadership to her own organization, is a recognized leader in Air Force Research Laboratory command, and has volunteered contributions at the national level for the FLC.

Ms. Schario works extensively with personnel to identify collaboration opportunities with other federal agencies. Due to her extensive activity and network of FLC contacts, she acquires and maintains a significant database of up-to-date knowledge of research going on in other federal agencies. Ms. Schario has expertly used this knowledge to identify multiple potential partners for research efforts at her laboratory. One recent example led to a partnership between the Air Force Research Laboratory and the Department of Energy.

Ms. Schario has shared her successful expertise on identifying technology transfer partners with others in the FLC through briefings and presentations, so that other laboratories would have an opportunity to implement it in order to improve their rates of successful commercialization. She is also active in the marketing of technology transfer, by regularly contributing to FLC NewsLink, and organizing tours and presentations for other government agencies, partners, and companies interested in technology transfer opportunities. Ms. Schario's exceptional leadership in technology transfer has set a model of success for other representatives to emulate.

2001 FLC Laboratory Director of the Year: Philip Brandler

In his capacity as laboratory director, Mr. Brandler ensures that every opportunity is taken to support and promote technology transfer efforts. He encourages his researchers and engineers to develop technologies and products right from the start with both military and commercial applications in mind.

Under Mr. Brandler's leadership, technology transfer activities at the Natick Research Center have steadily increased over the past several years. Currently, the laboratory has 37 active CRADAs with such notable companies as L.L. Bean, Frito-Lay, W.L. Gore, DuPont, and Sara Lee.

Of particular note, Mr. Brandler's technology transfer efforts resulted in the establishment of the National Protection Center, a joint pilot agency program operated

in conjunction with the NASA Ames Research Center, and the National Institute for Justice Office for Law Enforcement and Corrections Technology. As a consolidated source of expertise and resources, the National Protection Center provides state-of-the-art protective equipment for military personnel as well as civilian emergency personnel, saving millions in taxpayer dollars.

Defense Department 2001 FLC Awards for Excellence in Technology Transfer

Transferring Technology for and to Students

Gerald Mora, Ronda Cole, Marla Griego and Raina Pellegrino, Air Force Research Laboratory at Kirtland Air Force Base

Of all technology transfer activities, education outreach has the greatest impact on the future by benefiting those who have the biggest stake in the future: today's students. AFRL's Technology Transfer for Education (TTE) Program team touches the future by bringing the technology and expertise of Air Force research and development (R&D) scientists into New Mexico classrooms.

The team meets educators' needs by providing mentors, technologies, and methodologies to bridge the gap between lagging education resources and cutting-edge, real-world technologies. Mentors involved in the TTE Program work in such diverse fields as computer science, physics, chemistry, and engineering. The students they mentor receive a broader understanding of potential career fields available to them and what educational planning is necessary to succeed. The mentoring activity concludes with a student team's full development and the completion of an R&D activity based on a specific technology area.

The AFRL team uses both Education Partnership Agreements (EPAs) and Cooperative Research and Development Agreements (CRADAs) with school districts as mechanisms to pursue technology transfer. This involves using the teachers and students in Air Force R&D, as well as donating or loaning equipment to participating schools. The effort that the AFRL team has put forth is yielding positive results. Over 39,000 students from more than 120 New Mexico schools have benefited from the TTE Program, resulting in increasing student success in math, science and technology curricula. The TTE program has received state and national recognition, including commendations from the New Mexico Legislature, the Governor of New Mexico, and the New Mexico members of the U.S. House and Senate. In addition, the team received including the General Yates Award, the highest honor that can be bestowed on an Air Force technology transfer project.

Everyone who participates in the TTE Program reaps its benefits. Teachers benefit by having resources to enhance their math, science, and engineering courses. Students have the opportunity to be involved in unique educational opportunities offered by AFRL. Mentors benefit from the opportunity to strengthen their leadership skills by working with the students and teachers. Most importantly, the state of New Mexico benefits by having students with stronger interests in math, science and engineering, thus increasing the future job applicant pool in those areas.

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Holographic Polymer-Dispersed Liquid Crystals (H-PDLCs)




Dr. Wade Adams, Dr. Larry Bidwell, Dr. Tim Bunning, Fred Sinder
Air Force Research Laboratory (AFRL), Materials and Manufacturing Directorate

Research by the AFRL Materials and Manufacturing team has led to significant technological advancements in the development of a wearable holographic display that allows pilots to keep their eyes on the action while viewing data and color images projected directly into the retina. Holographic polymer-dispersed liquid crystals (H-PDLCs) allow complex optics to be designed into lightweight thin films whose optical properties can be changed by applying a modest electrical field similar to that used in watch and calculator displays. This technology replaces bulky and relatively heavy lenses by reducing component weight and size.

The effort to transfer this technology took shape when the AFRL team partnered with Science Applications International Corporation (SAIC) to license the H-PDLC. After achieving initial success and discovering the vast commercial outlets in which the technology could be used, SAIC became interested in securing the intellectual property rights to H-PDLC and marketing it. A dual-use cost-share program was utilized to move the technology even further. Based on the success of the technology transfer efforts, a startup company was created - DigiLens of Sunnyvale, California - which has an exclusive agreement with SAIC to commercially develop the technology.
As the H-PDLC expands its presence in the marketplace, industries will find its versatility a plus. The lightweight high-resolution optical display may someday provide the warfighter with an added advantage in combat situations. The H-PDLC will also enable next-generation cellular phone displays for the Internet; wearable displays for

videos, game devices and personal computers; and improvements in rear-projection high definition television.

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In Situ Densification of Carbon-Carbon Composites

Dr. Wesley Hoffman, Dr. Steve Jones, Dr. Philip Wapner, Dr. Kevin Chaffee, Tom Duffey, Philip Counts, Hong Phan, and Marietta Fernandez
Air Force Research Laboratory (AFRL), Propulsion Directorate (PROP)

The use of carbon-carbon composites is crucial to the construction of aerospace equipment, including aircraft brakes, rocket nozzles, exit cones, and nose tips. Significant costs are associated with manufacturing equipment using these composites, as well as lead times as long as six to eight months. There is a long-standing need for carbon-carbon composites that not only have a uniform density, but can also be fabricated in thick pieces. In addition, as the composites are used in additional applications, there will be interest in producing them at a lower cost. To this end, the team has developed a low-cost, rapid processing route for the production of high-quality carbon-carbon composite material.

In Situ densification places matrix material between the carbon fibers and produces composite materials in 5 to 25 percent of the time and at 10 to 50 percent of the cost of current commercial processes. In addition to being more rapid and less expensive than commercial ones, the in situ process can produce carbon-carbon composites that cannot be produced by any other technology.

Once the team developed this technology, they entered into a Cooperative Research and Development Agreement (CRADA) with B.F. Goodrich Aerospace, the world's largest manufacturer of aircraft brake material. As a result of the CRADA, Goodrich has been able to incorporate the lab's densification process into its production cycles. Another technology transfer partnership involves SMJ Carbon, a spinoff company, which negotiated an exclusive license to manufacture carbon-carbon products for all markets except aircraft brakes.

Currently, both technology transfer partnerships are still in progress and are proving to be successful for all parties involved. The uniqueness of the in situ densification process provides a combination of benefits. Not only is it less expensive and quicker than other processes, it also produces a superior product with more uniform density. In addition, the process can densify thicker parts than other methods. The material can also be used in a number of diverse applications, including thermal management,

chemical processing, silicon wafer processing, and high temperature furnace components.

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The Second Generation High Temperature Superconducting Wire

Dr. Paul Barnes
Air Force Research Laboratory, Propulsion Directorate

The Air Force is placing significant emphasis on the development of directed energy weapons (DEW) for tactical and support operations. Large amounts of power are required, particularly for high power microwave weapons. Although this power can be provided by conventional means, it requires large and heavy generators that impede battlefield mobility and, in particular, make airborne operations impossible. High temperature superconducting (HTS) yttrium barium copper oxide (YBCO) generators are significantly lighter and more compact, thus enabling the DEW technology.

Dr. Barnes has developed several technologies that make it possible to manufacture the YBCO coated conductors. A highlight of this research is the discovery of a previously unknown substrate grain boundary effect in coated conductors. This effect has a strong influence on the critical current that the HTS film can carry. Dr. Barnes has successfully transitioned YBCO coated conductors and many other AFRL-developed technologies to industry by developing and nurturing collaborative efforts involving multiple industry partners.

Dr. Barnes initiated and led the development of a Cooperative Research and Development Agreement (CRADA) among Intermagnetics General Corporation (IGC), the Materials Laboratory, and the AFRL, as well as securing cost share funding from IGC. This resulted in the establishment of a new company, IGC SuperPower, LLC. The new company will use AFRL-developed technology to produce YBCO coated conductors. In June 2000, IGC SuperPower opened a new YBCO coated conductor manufacturing facility.

Dr. Barnes also played a key role in creating a partnership with the University of Wisconsin Applied Superconductivity Center and the AFRL Superconductivity Group. This partnership resulted in the discovery of a grain boundary effect that sets a standard for substrate grain alignment for production of the textured substrate used in HTS coated conductors by industry.

The discovered grain boundary effect has helped the entire HTS coated conductor industry develop improved products. All of these technologies improve the coated conductor samples currently made, and help in the development of the long-length

coated conductor that is needed in the power utility market and the high power generators used by the military. Complete development of the technology will lead to industrial commercialization of the YBCO coated conductor in such electric power applications as transformers, transmission cables, motors, fault current limiters, and generators.

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An ARL Communications Technology Success Story

Dr. Louise Sengupta, Dr. Somnath Sengupta, Luna Chiu, Xubai Zhang, Steven Stowell, Eric Ngo, and Jennifer Synowczski
Army Research Laboratory (ARL)

A team of ARL scientists developed a new ceramic material technology with far-reaching possibilities for both military and commercial communications and radar. Using a unique ferro-electric ceramic material, the team designed low-cost, tunable scanning antennas for satellite communications, voltage tunable filters and devices, and ultra-fast scanning phase shifters.

The Army's belief in the team's abilities-along with its significant need to reduce the size, weight and cost of existing ferrite phase shifters-resulted in its funding of this successful effort for more than six years. Once ARL's state-of-the-art technology was created, decisions were made about how to best transfer it. Four members of the team created a private firm, called Paratek, that would license the patents that are the heart of the ceramic material technology, while two members of the team remained at ARL to work on the military application of the technology. An exclusive license was negotiated by ARL and signed by Paratek in late 1999, thus marking the first time in Army history that an employee inventor team would license the technology they invented.

In the years since its startup, Paratek has grown from four employees to 90, and the products the company is preparing for production range from new to revolutionary. The company's ceramic material technologies will be used in personal communication devices, cell phones, and home and office direct satellite communication systems as enabling technology that can both reduce cost and expand capability. This technology has far-reaching consequences-not only for critical military needs, but also for an estimated billion dollar commercial field of broadband wireless communication systems.

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Centrifugal Casting of Metal Matrix Composites

Amarnath Divecha and Subhash Karmarkar
Carderock Division, Naval Surface Warfare Center

Because of the hazard asbestos poses, the Navy can no longer use brake shoes made of asbestos on bronze friction drums. Shoes using replacement materials destroyed the drums in about 100 hours of use. A new material was needed for the drums that would reduce the amount of wear and tear. This team invented a composite casting technique that creates a material as strong as asbestos.

By carefully selecting a metal alloy for matrix metal (such as aluminum) reinforced with other materials (such as silicon carbide), as well as a very hard powder for the desired wear-resistant characteristics, the team created a wide variety of parts, including tubes, brakes, clutches and gears, that have different material properties. Depending upon the respective densities of the metal matrix and the particles, it is possible to produce tailor-made composites with reinforced wear surfaces on the outer or inner surface of the part as desired. The Navy constructed friction drums using this material and, in nearly 1,000 hours of use, the drums with the replacement metal matrix composites have shown no significant wear.

Divecha and Karmarkar partnered with two companies to transfer the technology through Cooperative Research and Development Agreements (CRADAs) and licensing. John Crane Marine intends to apply the technology to shipboard mechanical seals, which are very expensive and must be replaced frequently. Using the metal matrix composites will significantly reduce operating costs for the company. MSE Technology Applications, Inc. will apply the technology to a number of items, including disc brake rotors, golf clubs, boring tool disks and electronic heat sinks, to create longer lasting materials at a lower operating cost.

It is estimated that this technology will save the Navy as much as $38 million during the next five years without returning to the use of asbestos brake shoes. In addition, Metal Matrix Composites will provide benefits for builders and consumers of high performance automobiles, long distance trucks, airplanes, and ships.

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LaserNet Fines Optical Debris Monitor

Dr. John Reintjes, Dr. John Tucker, Chao Lu, Dr. Abraham Schultz, Amy O'Brien, Lawrence Tankersley, Jefferson Willey, Paul Howard, and Scott Thomas
U.S. Naval Research Laboratory (NRL)

Industry studies show that about 25 percent of U.S. production capacity is inoperative at any given time due to mechanical failure. The consequences of such failures vary from inflated prices, lost productivity, production delays and increased costs, to loss of life and personal tragedy if the equipment that fails is a component of an airplane, helicopter, or other vehicle. Maintaining equipment properly to avoid failure is also time-consuming and expensive. This NRL team has developed a system that can automatically detect mechanical defects.

The LaserNet Fines (LNF) Optical Debris Monitor is a broadly applicable, optically based system that automatically detects and identifies faults or incipient failure in mechanical systems due to excess wear, and detects contamination in hydraulic and fuel systems. The monitor determines the size distributions of debris particles in lubricating systems and classifies the particles according to the mechanical process responsible for their production. The LNF also identifies contaminants in hydraulic and fuel systems from external sources such as sand, fiber, and water.

The NRL team transferred the technology by entering into a licensing agreement with Lockheed Martin, which in turn entered into an agreement with Spectro Inc. for marketing and distributing the monitor. In addition, the LNF system is already deployed onboard ships to improve the Navy's condition-based maintenance programs.

The LNF will benefit numerous industries, including railroad and trucking, electric power generation, construction, commercial shipping, commercial airlines, mining, and offshore oil drilling. Use of the LNF results in the improved safety, reliability, and availability of a wide range of mechanical equipment, accompanied by substantially reduced maintenance costs in terms of both personnel and operations. Additionally, safety is increased by substantially reducing failures that occur during operation, which lowers liability costs.

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Quantitative Mobility Spectrum Analysis (QMSA) for Evaluating Semiconductor Electronics Materials

Dr. Jerry Meyer, Dr. Craig Hoffman, Dr, Igor Vurgaftman, Dr. Filbert Bartoli
Naval Research Laboratory (NRL)

The Quantitative Mobility Spectrum Analysis (QMSA) is a new method, developed by this NRL team that characterizes the fundamental electrical properties of layered semiconductor structures. From electrical measurements as a function of a magnetic field, QMSA can simultaneously determine the properties of as many as ten different charge carriers in a complex multilayered structure. These properties are directly related to the performance of semiconductor-based devices, such as high-speed computer circuits, making QMSA a valuable new tool for research and development, diagnostics, and quality control in the areas of semiconductor manufacture and research.

NRL worked with the University of Western Australia to develop the QMSA, constructing its software architecture into a commercially marketable package. Once the technology was commercially viable, the lab then identified Lake Shore Cryotronics, Inc. (LSCI), a developer and international supplier of technology for property measurement and process control, as an excellent commercial partner. NRL and LSCI signed a Cooperative Research and Development Agreement (CRADA), as well as a licensing agreement. Under the patent license, LSCI is selling QMSA as a software product.

By using QMSA to monitor materials in near real-time, manufacturers can increase product quality and decrease the number of wafers that fail to meet specifications, leading to an overall reduction in cost. The semiconductor chip industry is intensely competitive; thus, any cost savings are especially important to profit margins.

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Single Molecule Biosensors

Dr. Richard Colton, Dr. David Kidwell, Dr. Gil Lee, Dr. John-Bruce Green, and Dr. David Baselt
Naval Research Laboratory (NRL)

The single molecule biosensors developed by this NRL team represent a revolutionary class of biosensors that are capable of detecting a variety of biomolecules, including proteins, viruses, and bacteria. The patented biosensors use the principles of atomic force microscopy (AFM) to measure the strength of single DNA-DNA and antibody-antigen bonds-in effect detecting and characterizing single molecules of DNA or antigen.

The NRL team transferred its technology to Gravitron, Inc., which is negotiating a sublicense to a large biotechnology company. Gravitron intends to apply the technology in a number of areas, including biological diagnostics, environmental monitoring, and portable gas monitoring. By linking micromachined sensors to basic biological and chemical methods, the single molecule biosensors will provide unprecedented sensitivity, cost-effectiveness, accelerated data management, integration, and reliable detection. Moreover, since the entire process is conducted on a single chip, it is inherently smaller and less expensive than other sensors.

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The Temporally Ordered Routing Algorithm (TORA)

Vincent Park
Naval Research Laboratory (NRL)

Computer and communication networks such as the Internet are multilayered, highly complex systems that rely on a plethora of protocols and algorithms for seamless, reliable operation. However, the traditional routing algorithms used in today's networks are designed for operation in relatively static hardwired networks and are not well-suited for emerging mobile wireless networks. Park has created an enabling technology for the development of mobile wireless networks.

TORA possesses the essential aspects of traditional approaches, but also has unique attributes that make it better suited for use in the more dynamic and bandwidth-constrained wireless networks needed to support our increasingly mobile society. Park designed the technology to minimize communication overhead, thus preserving the precious bandwidths and resources of wireless systems. TORA establishes a multipath routing structure that improves robustness and reduces the frequency of protocol reactions to network dynamics. Designed to be highly adaptive, efficient and scalable, TORA has the properties essential to support the intended network environment.

Park's technology, which has a patent pending, resulted from his master's thesis research at the University of Maryland (UMD). The University was also a partner in the technology transfer effort, as NRL negotiated a licensing agreement with UMD and

Nova Engineering, Inc. Currently, Nova Engineering has marketed a wireless router product (the NovaRoam 900) that is based on the TORA technology. In addition, Park's technology transfer partnership with UMD has proven to be so successful that the university is looking for other licensing opportunities from NRL.

This technology enables the deployment and use of computer and communication networks in new environments and applications where networking was previously not possible. By facilitating the formation of mobile wireless networks, TORA supports the extension of Internet-type information and services to users on the move or in remote locations-such as establishing a telemedicine link between a doctor in a hospital and a paramedic at a remote site, or providing current tactical information to rapidly deploying Marines in hostile territory. The range of potential applications for this technology and the communities that it can benefit are vast.

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Automated Oil Spill Detection System

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Space and Naval Warfare Systems Center, San Diego (SPAWAR)

Rapid, reliable spill detection is an essential yet often overlooked part of oil spill prevention and response strategies. Early detection of a petroleum leak or spill enables responders to take immediate actions to stop and contain the released material. By enhancing the ability to exercise timely countermeasures, early detection offers an effective means of minimizing the environmental and financial impact of a spill. On the other hand, a failure or delay in recognizing the existence of a spill leads to a delayed response, which may result in a larger spill volume and costlier cleanup effort. Current oil spill detection methods rely solely on human observation to identify the presence of a spill-a very unreliable practice. To address this issue, the SPAWAR team developed an automated spill-sensing technology.

The automated technology provides early notification of a petroleum spill on water. The fluorescence-based sensor operates just below the water surface and continuously tests for an increased hydrocarbon concentration, which is indicative of a spill. When a spill is detected, a radio signal is immediately transmitted to a base station computer for analysis, display, and electronic alarming. Once a spill has been detected, responders immediately receive an automated phone call alerting them.

To transfer the technology, the SPAWAR team entered into a licensing agreement with Applied Microsystems Ltd. (AML), a Canadian company that designs and manufactures water quality monitoring instrumentation. Currently, AML is marketing the detection system globally under the name "Spill Sentry."

This technology will provide numerous benefits since it has the potential to significantly reduce the amount of oil that enters the environment every day due to pipeline leaks, tank overflows, and illegal dumping. In addition, it will serve to minimize the resulting adverse economic and environmental impacts caused by unpreventable spills. The public will benefit from a cleaner aquatic environment made possible by SPAWAR.

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Micro-displays

Dr. Stephen Russell
Space and Naval Warfare Center, San Diego

Dr. Russell invented a novel, high performance micro-display that allows high performance microelectronic circuitry within and adjacent to a transmissive liquid crystal display to be fabricated. The result is a high resolution and high brightness display that eliminates the need for millions of interconnections between the display and its control circuitry. Dr. Russell's technology offers improved imaging and video in virtual presence applications for war fighter and emergency service personnel, as well as in advanced devices such as hand-held computers and cellular phones.

To transfer the technology, Dr. Russell used an innovative process that formed a coalition of government and industrial partners. Subsequently, the Center entered into a Cooperative Research and Development Agreement (CRADA) with Proxima Corporation to market the technology. A second CRADA was established with Optron Systems, a display and component manufacturer. Both CRADAs resulted in licensing agreements for Dr. Russell's invention. In addition, Radiant Images-a spinoff company from Optron Systems-will produce the first commercial version of the micro-displays within the next year.

The initial beneficiaries of the technology will be the Department of Defense and emergency service personnel. As the technology becomes commercially available, it will have the greatest impact on portable information technology devices.

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